PRE-LAUNCH PHASE 2 CALIBRATION AND VALIDATION REHEARSAL OF GEOPHYSICAL DATA PRODUCTS OF SOIL MOISTURE ACTIVE PASSIVE (SMAP) MISSION

Andreas Colliander[1], Thomas Jackson[2], Scott Dunbar[1], Steven Chan[1], Narendra Das[1], Seungbum Kim[1], Rolf Reichle[3], Gabrielle de Lannoy[3], Qing Liu[3], John Kimball[4], Yonghong Yi[4], Chris Derksen[5], Xiaolan Xu[1], Michael Cosh[2], Rajat Bindlish[2], Wade Crow[2], Fan Chen[2], Lan Dang[1], Michael Spencer[1], Simon Yueh[1], and Eni Njoku[1]

[1]*Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA*
[2]*USDA ARS Hydrology and Remote Sensing Laboratory, Beltsville, MD, USA*
[3]*NASA Goddard Space Flight Center, Greenbelt, MD, USA*
[4]*Flathead Lake Biological Station, University of Montana, Polson, MT, USA*
[5]*Climate Research Division, Environment Canada, Toronto, ON, Canada*

1. INTRODUCTION

NASA's Soil Moisture Active Passive (SMAP) Mission is scheduled for launch in early November 2014. The objective of the mission is global mapping of soil moisture and freeze/thaw state. SMAP utilizes L-band radar and radiometer sharing a rotating 6-meter mesh reflector antenna. The instruments will operate onboard the SMAP spacecraft in a 685-km Sun-synchronous near-polar orbit, viewing the surface at a constant 40-degree incidence angle with a 1000-km swath width. Merging of active and passive L-band observations of the mission will enable an unprecedented combination of accuracy, resolution, coverage and revisit-time for soil moisture and freeze/thaw state retrieval. SMAP measurements will enable significantly improved estimates of water, energy and carbon transfers between the land and atmosphere. The SMAP science data product suite of geophysical parameters will include estimates of surface (top 5 cm) and root-zone (down to 1-m depth) soil moisture, net ecosystem exchange (NEE), and classification of the frozen/non-frozen state of the landscape. [1]

2. GEOPHYSICAL DATA PRODUCT CAL/VAL PLAN

The primary validation reference of the data products will be ground-based measurements. Well characterized sites with calibrated in situ measurement will be used to determine the quality of the data products. The sites are called core validation sites. The mission success criteria are evaluated with respect to these core site comparisons. Other remote sensing and model-based products will be used as additional resources to expand the spatial and temporal scope of the evaluation. The post-launch timeline of the mission requires that the geophysical data products are validated during the Cal/Val Phase which is 12 months in duration and starts after a 3-month in-orbit check-out phase. In an effort to ensure the geographic distribution and diversity of the climatological conditions, land cover type and soil type of the core validation sites SMAP is partnering with investigators at different parts of the globe. These Cal/Val Partners play a crucial role in the execution of the SMAP Cal/Val Plan. SMAP is taking several preparatory steps in order to meet the challenging schedule and guarantee the efficient collaboration with the Cal/Val Partners, one of which is the conducting rehearsals to exercise the calibration and validation procedures planned for the Cal/Val Phase. [2]

3. CAL/VAL REHEARSALS

The SMAP Cal/Val Rehearsal exercise is divided into two stages. Phase 1, which was conducted in June-August 2013, focused on validation methodologies for the geophysical data products. Phase 2, which will be conducted in May-June 2014, includes operational aspects including a fully functioning SMAP Science Data System (SDS). It is noted that the rehearsals do not include an airborne field campaign.

Phase 1 of the rehearsal included: generation of simulated SMAP data products for the soil moisture and NEE products (freeze/thaw product was not included); establishing automated data transfers of both small-scale, dense and large-scale, sparse in situ networks operated by a subset of SMAP Cal/Val Partners; exercising of in situ data transfer protocols, and in situ data formatting, comparison and metric computation tools; and running inter-comparisons between the simulated products and other satellite and model-based products. The simulated products were mostly based on climatology of another year. However, concurrent SMOS brightness temperature measurements were used as the basis of the simulation of the radiometer-based soil moisture product. The comparisons were made with data from a period starting in May 2013 and accumulated during the course of the activity, which forced the exercise of obtaining and processing recently acquired data. A large part of the time was devoted to establishing data transfers from the Cal/Val Partners. Phase 1 produced a list of actions and lessons learned which will be implemented by Phase 2 of the rehearsal. Most importantly a lot of progress was made establishing prototype system for core validation site data ingestion and processing for automated data product validation.

In Phase 2 the scope of the exercise will be expanded and the fidelity of both simulated SMAP products and cal/val tools will be improved. The simulated data products will include freeze/thaw product also and all of them will be based on concurrent land surface conditions and other satellite measurements. This way the comparisons with respect to the weekly downloaded core validation site data enable exercise involving the algorithm refinement and anomaly investigation procedures. Only a subset of the SMAP Cal/Val Partners participated in the Phase 1 but in the Phase 2 all Partners will be included in order to test the readiness of the whole system before the launch. The cal/val tools will be updated based on the experience from the Phase 1 and added functionalities include better control over the version of the evaluated product, standardized quality control of the reference data, improved formulation for utilization of the sparse networks and utilization of multiple reference data sets (model-based and satellite-based) for global comparisons. The Phase 2 ends about four months before the launch of SMAP which leaves time for final remedies and updates before the start of the Cal/Val Phase.

4. CONCLUSIONS

The activities of the Phase 2 of the SMAP Cal/Val Rehearsal will be described and the complete list of the SMAP Cal/Val Partners and core validation sites will be presented. The outcomes and conclusions of the exercise pertaining to the geophysical data products will be described, and the readiness of the system for the geophysical data product evaluation will be discussed.

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